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# Phosphorus and swine feeding

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**Abstract**
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**Keywords**
Animal Science, Agronomy


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This article focuses on developing a phosphorus (P) strategy for swine feeding operations and continues a series that provides producers with information on P management and environmental issues relating to P management.

## Swine production and P

Animal feeding operations can provide a significant source of nutrients for crops through manure. However, supplying manure that is nutrient-balanced for nitrogen (N) and P requires reducing the P content of manure, without compromising the performance of the livestock.

Optimizing nutrition while minimizing production costs and impact on the environment can be complimentary goals in swine feeding operations. Successful strategies include matching recommendations and requirements, selecting available P sources, and using additives to enhance P availability.

Current total P in finishing diets is usually 0.5 percent (Table 1). Reducing total phosphorus to 0.4 percent (Nutrient Requirements of Swine, National Research Council, 1998) reduces P excretion in manure by 27 percent. Adding phytase reduces P by 54 percent. The economics of phytase additions can vary as prices of inorganic phosphorus sources fluctuate, but generally production costs are not affected by replacing dicalcium phosphate with phytase.

Supplementing feed with phytase is an excellent strategy for reducing phosphorus without sacrificing productivity. Adding 112 phytase units/lb to a P-deficient diet (0.40 grower/0.35 finisher) results in an average daily gain of 1.83 lb compared with 1.92 at recommended levels of P (0.50/0.40) (Table 2). Dropping from recommended levels of P (0.50/0.40) to P-deficient diet (0.40/.35) without a phytase supplement results in a significantly lower daily gain of 1.56 lb. Similar responses are observed for feed intake and feed efficiency.

Recently developed low-phytate corn varieties have much higher available P content. Feeding decreasing levels of total P (compared with normal corn varieties) maintains performance until total P is reduced to 0.33 percent (0.09% bioavailable) (Table 3). However, when fed low-phytate corn, pigs that are fed at similar total P levels perform equally, with the exception of femur strength at the lowest level (Table 3).

Land application of manure by P content. Phytase additions may provide another benefit to producers. Optimum formulations combined with the use of phytase may result in reduced P excretion, and thus the land acreage required for manure application. The acreage required for manure application—based on N and P balance—is shown in Table 4. To balance corn

utilization of N with 1,000 feeder pigs, approximately 110 acres of corn with yields of 150 bu/acre is required. However, this N-balance formula results in a P application rate that adds 71 lb more P/acre than can be used by the crop.

For manure application based on P application rates, the acreage required would increase from 110 needed for nitrogen to 240 acres for P (at the same yield of 150 bu/acre) (Table 4). However, reduction of P excreted, through better P management, can reduce the acreage required to apply manure according to P content. The acreage required decreases from 240 to 99.

In addition to reducing the land required, better P management can produce a complimentary balance for N and P content in manure. The 99 acres required for 1,000 feeders for crop P is close to the 110 acres required for N, satisfying the nutrient needs of most crop applications in Iowa. If manure nutrients are in balance, it is possible that no commercial N or P would be needed.

## Summary

Phytase enzyme or low-phytate corn with reduced levels of inorganic P supplementation can be fed to swine without sacrificing performance or carcass characteristics. And because these technologies maintain performance levels and provide nutrient-balanced manure for land application, the economics are definitely worth a look.

**Table 1. Potential for reducing P excretion in 175-lb pigs.**

| Dietary P | Current 0.5% | NRC 0.4% | Phytase 0.3% |
|---|---|---|---|
| P intake, grams/day | 15.5 | 12.4 | 9.3 |
| P retained, grams/day | 4.0 | 4.0 | 4.0 |
| P excreted, grams/day | 11.5 | 8.4 | 5.3 |
| Reduction in P excretion from current practice, % | | 27 | 54 |

NRC, National Research Council.

Source: *Cromwell Feedstuffs*, October 7, 1991.

**Table 2. Phytase for grower/finisher pigs.**

| Grow/finish P, % | .50/.40 | .40/.35 | .40/.35 |
|---|---|---|---|
| Phytase, U/l[b] | 0 | 0 | 112 |
| ADG, l[b] | 1.92[a] | 1.56[b] | 1.83[a] |

| | | | |
|---|---|---|---|
| ADF, l[b] | 4.72[a] | 4.01[b] | 4.61[a] |
| F/G | 2.47[a] | 2.55[b] | 2.52[a,b] |

ADG, average daily gain; ADF, average daily feed.

[a,b] Values with different superscript letters in a row are significantly different, P < 0.03; Virginia Polytechnic Institute and State University (BASF KC9614) 1996.

### Table 3. Normal versus low-phytate corn for growing pigs (51-112 lb).

| **Normal corn** | | | | |
|---|---|---|---|---|
| Total P, % | 0.59 | 0.50 | 0.42 | 0.33 |
| Bioavailable P, % | 0.35 | 0.26 | 0.18 | 0.09 |
| ADG, lb | 1.78 | 1.76 | 1.61 | 1.37 |
| Feed/gain | 2.37 | 2.37 | 2.44 | 2.79 |
| Femur strength, kg | 308 | 301 | 234 | 125 |
| **Low-phytate corn** | | | | |
| Total P, % | 0.59 | 0.50 | 0.42 | 0.33 |
| Bioavailable P, % | 0.45 | 0.37 | 0.28 | 0.20 |
| ADG, lb | 1.74 | 1.72 | 1.72 | 1.70 |
| Feed/gain | 2.39 | 2.54 | 2.38 | 2.35 |
| Femur strength, kg | 332 | 332 | 298 | 208 |

ADG, average daily gain. Bold values significantly poorer.

Source: *Cromwell*, University of Kentucky (1998). Diets with 0.33 percent P contained no supplemental P.

### Table 4. Acres required for manure application.

| **N balance (1,000 feeder pigs)** | | | |
|---|---|---|---|
| Corn, bu/acre | 150 | 175 | 200 |
| N balance, acre | 110 | 90 | 80 |
| Excess P, lb/acre | 71 | 90 | 100 |
| **P balance (1,000 feeder pigs)** | | | |
| Corn, bu/acre | 150 | 175 | 200 |

| | | | |
|---|---|---|---|
| Normal P, acres | 240 | 205 | 180 |
| Half P level, acresa | 99 | 85 | 75 |

Corn on corn rotation.

Source: *Liquid Manure Storage and Handling* (ISU Extension publication MCS 18). aAssumes 50% reduction in P in manure.

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